REMARKS

Applicant hereby requests further consideration of the application in view of the amendments above and the comments that follow. This amendment is submitted in reply to the Office Action mailed May 5, 2005 ("the Action"). Claims 1-24 are pending in the action but stand rejected under one or more of 35 USC §112, second paragraph, §102 or §103.

I. The 35 USC §112, Second Paragraph Rejections

The Action rejects Claims 9-11 and 20 under 35 USC §112, second paragraph, as being indefinite for the recitation of certain claim informalities. Applicant has amended the affected claims to obviate these rejections, and therefore requests that these rejections be withdrawn.

II. The Art Rejections

The Action rejects Claims 1-7, 8-10, 12-19, 21, 22 and 24 as being anticipated by U.S. Patent No. 5,619,995 to Lobodzinski ("Lobodzinski"). The Action rejects the other claims as being obvious over Lobodzinski in view of certain secondary references. Applicant respectfully disagrees.

The Action concedes that much of the Lobodzinski disclosure is directed to ultrasound, but then states that Lobodzinski notes that other systems such as "cardiac Magnetic Resonance Imaging apparatus (col. 8, lines 10)" may also be used. (Action, p. 3).

In response, Applicant respectfully submits that Lobodzinski is directed to "video" signals rather than MRI cine loops. Lobodzinski states that "[t]he system of the present invention utilizes real-time image compression to store digitized video to a disc media in a continuous real-time fashion, thus making it possible to store the entire study with no possibility of losing data" (col. 5, lines 19-25). Lobodzinski states that "DIS generates a video signal 14. .... Other DIS may be ... a cardiac MRI apparatus.... The video signal can be generated in either analog or digital form. A Video Processor (VP) is in communication with the DIS for receiving the video signal." *See*, Lobodzinski, col 8, lines 6-15.

Lobodzinski discusses various prior art methods such as X-ray angiography (col. 2, lines 37) and characterizes them as being different, because they use only selected still images (col. 2, lines 40-45) and do not utilize real-time video compression. Lobodzinski also states that its proposed methods are distinctively different from the described methods of stress echocardiography (col. 5, lines 15-18). Thus, Lobodzinski itself stresses the technical differences from video versus still images used for cine, such as those used with MRI cine loops (see col. 2, lines 34-45, and col. 5, lines 10-25).

The instant invention does not employ a video signal coming from the MR scanner, but rather employs separate digital snapshots of the heart taken at various times. As Lobodzinski states with respect to technologies that use still images, Applicant submits that the reverse is also true: the instant invention is "distinctively different" from the real-time video system proposed by Lobodzinski.

For example, Applicant submits that a video stream is a synchronous data transmission including control signals and image information combined in such a manner that the stream can be displayed on a television monitor if it is in analog format. NTSC and PAL are two of the standard forms of analog video streams. AVI and MPEG are newer forms of digital video streams, which also contain control signals for playback. A complex decoding of the control signals is required to be able to display or manipulate the stream, as indicated in Lobodzinski's patent, which frequently refers to a "video processor". The frame rate is embedded into the control signals (typically 30 frames per second).

In contrast, according to MRI cine loops, there is no video stream; rather, there are individual digital snapshots of the heart at various points in time, which are stored as individual pixels in a two- or three-dimensional array on a computer. There is no stream, that can be connected to an NTSC or PAL monitor to view a cine loop. The snapshots are loaded into a computer program, which can display the snapshots in a sequential manner, at an arbitrary, typically user-selected, frame rate. Thus, discrete images (*e.g.*, Dicom format) can be handled in the same way that a set of TIFF format images would be handled.

Applicant also notes that MRI acquisition of these snapshots is very different from ultrasound, the primary target of Lobodzinski's patent. Ultrasound captures image data in

real-time, at 30 fps, which is then encoded into a video stream for display on a television screen or saved to storage media. MRI builds up a collection of snapshots of the heart at various points in the cardiac cycle, but these snapshots require many heartbeats to acquire, and, hence, are simply representative of typical images of the heart averaged over those many heartbeats. Further, there is only one set of frames spanning the one 'representative' heart cycle. In a video stream, there is a real-time stream of many heartbeats.

Applicant respectfully submits that synchronization of discrete MRI digital image snapshots of the instant invention is technically different from that proposed by Lobodzinski, which synchronizes (ultrasonic) video streams. Examples of the latter include NTSC/PAL/AVI/MPEG video streams (Lobodzinski), while examples of the former include single-frame digital image formats (DICOM, TIFF and the like).

As further evidence of the meaning of MRI cine loops, Applicant has attached a reference for one of the early papers on cine MRI. Applicant submits that this document clearly describes the operation of MRI cine loops and makes it clear that clear that the images for one "reference" heartbeat are constructed from data acquired over many heartbeats, thus representing a sort of average heartbeat during that time. Only one heart cycle's worth of images is created and played over and over again, unlike real-time video in which each heartbeat seen is a distinct, separate heartbeat. *See, Quantification of cardiac function by conventional and cine magnetic resonance imaging.* Sechtem U, Pflugfelder P, Higgins CB. Cardiovasc Intervent Radiol. 1987;10(6):365-73. A copy of this document is attached hereto for the Examiner's ease of reference.

For ease of discussion, Applicant has restated the independent claims below.

1. A method of cardiac diagnostics of a patient, comprising:
administering a stress test to the patient;
acquiring a plurality of MRI cine-loops of the heart of the patient at a plurality of heart rates;
adjusting the plurality of MRI cine loops based on a heart rate associated with respective ones of the MRI cines so as to compensate for differences in heart rate; and
evaluating the compensated MRI cine loops so as to assess a state of coronary physiology of the patient.

21. A method of displaying MRI cine loops comprising:
adjusting a characteristic of one frame of a plurality of frames of an MRI cine loop; and
propagating the adjustment of the one frame to other frames of the MRI cine loop.

Applicant respectfully submits that Lobodzinski fails to anticipate the claims for at least the emphasized features noted above. Further, Applicant submits that Lobodzinski Lobodzinski teaches away from the claimed subject matter, as this reference stresses the continuous real time video image compression as a very different technology from other motion video and the use still or selected images to form cine loops and the alleged deficiencies thereof (col. 2, lines 33-45).

Claims 9 and 25

Regarding Claim 9, the Action states that Lobodzinski teaches that frames may be removed from the slower heart rate loop so that the cycles will be displayed simultaneously so that the temporal placement of the frames in each cycle are the same and so that each cycle has the same number of frames (emphasis added citing col. 13, line 15, 24-35 of Lobodzinski). However, as recited in amended Claim 9 and new Claim 25, the adjusting the plurality of MRI cine loops comprises adding frames from at least one of the plurality of MRI cine loops. Applicant submits that this feature is not taught or suggested by the cited reference.

Accordingly, Applicant respectfully submits that Claims 9 and 25 are patentable over the cited art.

Claim 11 (and amended Claim 9)

The Action concedes that the cited reference fails to teach repeating frames as recited in Claim 9 to adjust the cine loop. However, the Action then states that US 2003/0206646 to Brackett discloses a diagnostic system using cine loops for storing and displaying image data and that this reference proposes that duplicate frames can be inserted between existing frames (citing to para. 29). Thus, the Action concludes that it would have been obvious to one of

skill in the art to modify Lobodzinski to achieve smoother transitions "or to provide another way to achieve desired frame rate." Applicant respectfully disagrees.

Lobodzinski has a frame rate built in to its video stream/image compression. There would have been no need to modify this frame rate as suggested by the Action by repeating a frame. Further, Brackett is directed to ultrasound (para. 33), and the added frames are for temporal transition from one acoustic frame to the next. Brackett also states (at para. 29) that some acoustic frame averaging may be performed prior to scan conversion or on X-Y data rather than acoustic frames before scan conversion. Thus, Brackett proposes the repetition, along with the other averaging techniques, for "smoother transition", not duration of cine loop or synchronization, the latter of which facilitates, for example, side-by-side comparison of MRI cine loops of a patient. Thus, one of skill in the art would not have modified the reference in the manner alleged absent the teachings of the instant invention.

Applicant respectfully submits that Claim 11 is patentable over the cited art.

Claims 12 and 17 (and new Claim 26)

Applicant respectfully submits that Lobodzinski fails to teach or suggest that the frames that are added and/or removed are evenly distributed throughout an MRI cine loop as recited in Claim 12 or that the frames for which duration is adjusted are evenly distributed throughout the MRI cine loop as recited in Claim 17. Accordingly, Applicant respectfully submits that Claims 12, 17 and new Claim 26 (which recites similar features) are patentable over the cited art.

New Claim 25

Applicant also submits that the cited references fail to teach or suggest obtaining MRI images for the MRI cine loops using a fast gradient echo segmented k-space sequence with sufficient temporal resolution for identification of end of systole, the temporal resolution being between about 13-65 ms, with lower times corresponding to faster heart beats and higher times corresponding to slower heartbeats. Support for the claim can be found at page 8 of the specification. Applicant respectfully submits that Claim 25 is patentable over the

cited references.

Claims 21, 22 and 24

With respect to Claims 21, 22 and 24, the Action states that Lobodzinski proposes that when more than one video loop is selected for display, the display area is automatically adjusted and the size of all the frames in the selected loop and the other loops are adjusted as well (col. 12, lines 38-42 and Figure 6). However, this description simply refers to a "drop and drag" operation that allows a clinician to selected either a single study in full screen format to be displayed (Figure 4) or more than one study to be displayed. If more than one selection is made, the size of the video loops are adjusted accordingly on the display (Figure 6). Further, Lobodzinski states that video editing functions are activated after selecting edit button 70, and can be used for manual editing, such as still frame selection and start and stop of a video sequence (col. 12, lines 17-21). Thus, while Lobodzinski allows a clinician to choose one or more number of studies to view, this selection merely then automatically sizes the selected video loops to be able to display them simultaneously. Lobodzinski does not teach or suggest adjusting one viewing parameter or characteristic on one frame that is then transmitted to the other frames.

Applicant respectfully submits that the cited reference fails to anticipate the subject matter of Claims 21, 22 or 24. As noted in the pending application, embodiments of the instant invention allow a clinician to rapidly adjust the display of the cine loop images by adjusting a feature in one frame that is propagated to other frames, thus not requiring each loop or frame be individually adjusted. The feature(s) can include, such as, for example, cropping to show only a portion of the original image, contrast, brightness, gamma or other display features, without adjusting each loop individually. Claim 22 recites that the frame is adjusted while there are a plurality of cine loops displayed. Claim 24 recites that the characteristic is a visual display level (opacity, brightness, contrast, etc.).

21. A method of displaying MRI cine loops comprising:
adjusting a characteristic of one frame of a plurality of frames of an MRI cine loop; and

propagating the adjustment of the one frame to other frames of the MRI cine loop.

22. The method of Claim 21, further comprising:
displaying a plurality of MRI cine loops during the adjusting step; and
automatically propogating the adjustment of the one frame of the first MRI cine loop to frames of the other MRI cine loops.

24. The method of Claim 21, wherein adjusting a characteristic comprises adjusting a visual display level of the frame.

Applicant respectfully submits that Lobodzinski fails to teach or suggest at least the emphasized features and that Claims 21, 22 and 24 are patentable over the cited reference.

Claim 23

The Action concedes that the primary reference fails to teach cropping frames to provide a portion of the frame, but opines that U.S. Patent No. 5,680,862 to Song et al. (Song) does so. Thus, the Action alleges that one of skill in the art would have found it obvious to modify Lobodzinski to use cropping.

At the cited passage, Song describes cropping an original image of 256x256 to a 64x64 region, but does so with respect to algorithims for deteriming the trajectory of a particle in motion based on allegedly an optimal computerized iteration method (Abstract). Song does not describe allowing user input to determine a crop region, then propagating the selected crop to other images in the cine loop, much less to the other displayed cine loops.

In contrast with Song, embodiments of the invention are directed to automatic propagation of a viewing parameter, using clinician input so as to allow a clinician to focus on a region of interest and cropping one frame, the subsequent images in the cine loop(s) then being automatically adjusted with the same selected crop detail. Thus, even combined, Song fails to remedy the deficiencies of Lobodzinski. That is, properly combined, the video loops of Lobodzinski would incorporate an optimized iterative method of determining trajectory of a moving region.

Applicant respectfully submits that Claim 23 is allowable over the cited art.

New Claim 27

Applicant also submits that new Claim 27 is patentable over the cited art, as the cited art fails to teach or suggest storing the defined viewing adjustment and subsequently automatically displaying the cine loops with the defined adjustment at a later time. Support for this claim can be found at page 14, lines 7-18 of the application.

CONCLUSION

Accordingly, Applicant submits that the present application is in condition for allowance and the same is earnestly solicited. Should the Examiner have any small matters outstanding of resolution, he is encouraged to telephone the undersigned at 919-854-1400 for expeditious handling.

Respectfully submitted,

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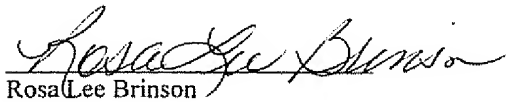

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